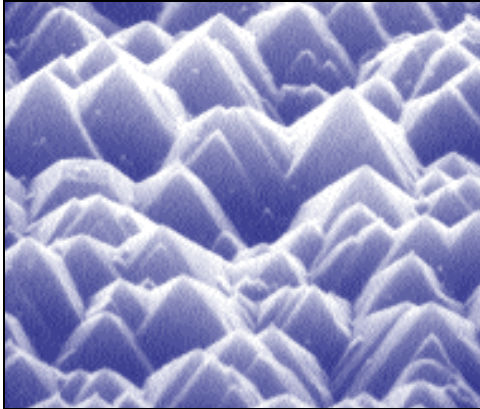


## SPIRE'S ION-BEAM APPLICATIONS



● *SPI-TEXT creates random patterns on surfaces that can be useful for many biomaterials.*

### BMDO HISTORY

With the help of BMDO SBIR contracts, Spire Corporation (Bedford, MA) developed an ion-beam texturization method that can create intricate surfaces on a variety of materials. For BMDO's Advanced Optical Baffles program, Spire used its patented SPI-TEXT method to create random patterns on optical sensors that aid in rejecting stray light. These sensors were used

in BMDO's moon-orbiting spacecraft, Clementine, as part of the light collection system for star tracking. The same texturization method plays an integral role in Spire's biomaterial product line.

**Bacterial endocarditis is**

**an infrequent complication**

**of valve replacement**

**surgery, but once acquired**

**it can be fatal to nearly**

**60 percent of patients. It**

**can also be acquired by**

**rheumatic heart patients**

**after simple surgery or**

**dental procedures. In both**

**cases it can usually be**

**prevented with antibiotics.**

### HOW IT WORKS

Spire developed an advanced surface modification technology based on ion-beam implantation and ion-beam-assisted deposition techniques. To produce optically dark surfaces, metals are bombarded with ions to create micrometer-scale textures, increasing surface area and providing light-trapping pores. For biomaterials that are either polymeric or metallic, this etching can alter surfaces for all manner of applications—for example, providing better anchoring for bacteria in petri dishes or, conversely, by coating and smoothing a catheter surface to prevent bacterial adherence.

### MEDICAL SIGNIFICANCE

While medical procedures certainly save lives and alleviate suffering, many of the physical invasions associated with modern practices automatically introduce new problems. Any device that is inserted into the body carries with it a threat of infection. Bacteria are often particularly attracted to polymers in portions of hip and knee implants, as well as indwelling catheters and heart valve sewing cuffs. They easily take up residence on these devices in a resistant covering called a biofilm. Even bacteria that are normally eradicable by antibiotics can avoid harm by colonizing implants in this manner. In addition, rough surfaces on medical devices can promote the formation of clots that can travel to the lung, heart, and brain, with devastating consequences.

One of Spire's latest efforts has been in impregnating replacement heart valve sewing cuffs with silver metal through an ion-beam process called SPI-ARGENT. This coating of elemental metal helps prevent bacterial

growth on the cuff, thus lowering the incidence of postreplacement endocarditis, a life-threatening infection of the heart's inner lining. In early June 1997, Spire announced an exclusive agreement with St. Jude Medical, Inc., to develop the heart-valve sewing cuff. St. Jude produces mechanical heart valves that are considered the gold standard in the industry. Using related technology, Spire also treats central venous catheters and surgical guide wires to reduce the likelihood of clot formation and increase lubricity, which eases the insertion process.

#### VENTURES OR PRODUCT AVAILABILITY

Spire's registered and trademarked techniques include the following:

IONGUARD enhances the mechanical and chemical surface properties of titanium alloy, cobalt-chromium, and other metal and ceramic orthopedic or dental devices. Overall, this process makes artificial joints more durable by increasing wettability and reducing friction; it also enhances adhesion to biocompatible cements.

SPI-TEXT texturizes electrodes used in cardiac pacemaker batteries. The increased surface area improves tissue attachment and decreases electrical resistance at the contacts. Testing showed that battery lifetimes were increased by 300 percent, electrode resistance was reduced, and battery weight was decreased. SPI-TEXT was licensed by a cardiac pacemaker manufacturer in 1993.

SPI-ARGENT treats polymer, metal, and ceramic medical devices to reduce the material's ability to induce blood clotting (increase thromboresistance), to reduce bacterial adhesion, and to improve hardness, slickness, and bondability of surfaces.

Spire's recently introduced line of central venous catheters is treated with a process called SPI-POLYMER. The process is designed to create a slick and thromboresistant surface for catheters.

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